Neal, Arthur

From: dirk.hoehler@degussa.com%inter2 [dirk.hoehler@degussa.com] on behalf of dirk.hoehler@degussa.com
Sent: Monday, August 08, 2005 4:19 PM
To: National List
Subject: TM-05-02 - Methionine in Organic Poultry Production

Attachments: Life Cycle Analysis of DL-Methionine.pdf

Life Cycle Analysis of DL-Meth...

Arthur Neal
Director of Program Administration
National Organic program
USDA-AMS-TMP-NOP

Dear Mr. Neal,

we appreciate the extend of methionine use in organic poultry production until October 21, 2008.

Methionine is an essential amino acid. At present, there are no alternative organic methionine-rich ingredients available in sufficient quantities.

I'm attaching a paper entitled "Life cycle analysis of DL-methionine in broiler meat production". In this work, we had an independent institute evaluate the production methods and the effects of DL-methionine in poultry feeds. The results are very clear-cut, please have a look.

With best regards,

Dirk Hoehler

(See attached file: Life Cycle Analysis of DL-Methionine.pdf)

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Life cycle analysis of DL-methionine in broiler meat production

by
Dr. Michael Binder

Poultry / Environment

Life cycle analysis of DL-methionine in broiler meat production

Key information

- This paper presents a comparative assessment of the ecological impact of methionine supplementation in poultry meat production, using either synthetic DL-methionine or natural methionine derived from vegetable proteins.
- The study provides an energetic assessment of the entire life cycle of DL-methionine by process chain analysis.
- The comparison looks at the provision of 1 kg methionine for supplementation of a methionine-deficient broiler ration with DL-methionine vs. additional protein from methionine-rich oilseeds. The impact of alternative feeding strategies on the environment is analysed by measuring critical environmental parameters.
- Supplementation of 1 kg synthetic DL-methionine requires less than one sixth of the energy needed to provide the equivalent amount of methionine from

soybean meal or rapeseed meal. The significant reduction in energy use also leads to considerably lower process-relevant emissions, resulting in a sustained contribution towards reducing environmental pollution (eutrophication and acidification).

Life cycle analysis

The Feed Additives Business of Degussa AG is the world's largest producer of amino acids for animal nutrition. The main focus is on poultry and pig meat production, because amino acids are building blocks of dietary proteins and as such constitute a major factor for animal growth.

Degussa AG is quoted in the Dow Jones Sustainability Index, therefore the Feed Additives Division is committed to a proactive and consistent policy in the area of environmental and health protection. This is demonstrated by efforts to assess the environmental pros and cons of its products by means of life cycle analysis (ecobalance). DL-methionine was the first product to be subjected to ecobalance testing in collaboration with the "ifeu" (Institute for Energy and Environmental Research, Heidelberg). The ISO 14040 to 14042 international standards were the basis for these tests.

DL-methionine is manufactured exclusively from petrochemical raw materials by a chemical process. It is also the most significant amino acid in animal nutrition measured by annual production value. The amino acid is currently produced at three locations in three countries. Degussa's production facility at Wesseling/Germany also produces all essential intermediates on site.

Methionine is an essential amino acid, which plays a critical role in broiler production as the first-limiting amino acid. A methionine deficiency limits protein biosynthesis, which means that other amino acids supplied with the diet can no longer be utilised. Methionine deficiency can be corrected either by the provision of synthetic amino acids or by increasing the proportion of methionine-rich natural feed ingredients, such as soybean meal or rapeseed meal.

Supplementing livestock diets with synthetic methionine enables to supply this limiting amino acid with a high degree of precision. At the same time, extracted soybean meal or rapeseed meal, which are extensively used in poultry production as sources of protein (and methionine), can be replaced by grains. The provision of the two alternative methionine sources was compared over their entire life cycles.

Ecobalance testing allows an objective assessment of the ecological benefits of fine-tuning the methionine content of typical broiler rations by the addition of synthetic DL-methionine.

Equivalent feed mixtures as functional units

In the ecobalance evaluation of DL-methionine, alternative options for increasing the methionine content of complete broiler rations were compared. Firstly, a practical DL-methionine supplemented diet was formulated which covers the bird's nutrient requirements (Diet A). In Diets B and C, dietary methionine content was raised by increasing the proportion of soybean meal or rapeseed meal, respectively.

The energy content of all three feeds was adjusted by varied amounts of vegetable oil supplementations. All three diets were formulated to contain the same level of true digestible methionine. The system "Diet A" is based on the technical production of methionine as a speciality chemistry product. In the second and third option (B, C) the methionine content of the ration is adjusted by increasing the proportion of soybean meal or rapeseed meal. System B has to include the cultivation of soybeans in North and South America, transport, and processing in an oil mill. In order to provide a nutritionally equivalent mixture, this automatically entails a reduction of the cereal content – in this case wheat – in the feed mixture, thereby lowering the energy content of the ration. The reduced amount of wheat is credited to the system. In order to cover the requirement for metabolisable energy, the ration is supplemented with energy-rich soy oil. The manufacture of oil is also included in the balance calculation. Provision of the equivalent amount of methionine through rapeseed meal (the most important methionine-rich European protein source) is evaluated and balanced in the same way.

Additionally, each product system considers the specific emissions associated with the altered feed composition (higher protein content), i.e., emissions caused by poultry droppings and manure applied to the land.

Table 1: Broiler rations formulated based on meeting the methionine requirement by supplementing DL-methionine (A) vs. increased amounts of soybean meal (B) and rapeseed meal (C)

Ingredients (%)	Diet A	Diet B	Diet C
Wheat	63.0	45.2	44.3
Soybean meal	**27.0**	**43.0**	**27.0**
Rapeseed meal	–	–	**15.0**
Soybean oil	5.0	6.8	5.0
Rapeseed oil	-	-	3.8
Minerals & vitamins	5.0	5.0	5.0
DL-methionine	**0.06**	–	–
Metabolizable energy (ME, MJ/kg)	12.7	12.7	12.7
Crude protein (%)	**20.4**	**25.7**	**23.2**
True digestible methionine (%)	0.31	0.31	0.31

The ecological comparison of the two product systems is limited to considering the respective differences relative to the basal mixture A. Both balanced product systems are shown in the simplified flow chart in Figure 1. By standardising the differences in the respective feed formulations in Table 1 to 1 kg methionine in each case, we can draw up the following comparative equation for further consideration:

1 kg DL-methionine

=

260 kg soybean meal
29 kg soybean oil
-288 kg wheat

=

250 kg rapeseed meal
29 kg rapeseed oil
-311 kg wheat

The manufacture of DL-methionine by the Degussa process (Figure 2) uses conventional petrochemical raw materials and comprises a series of synthesis steps in closed cycles with intensive recycling of by-products.

Adverse environmental effects

Resource consumption / energy use

The consumption of natural resources is considered an impairment of the basis of human life. The conservation of resources plays an important role in all considerations about sustainable management. The term "resources" is usually confined to non-renewable mineral or fossil resources, which is closely related to the total consumption of energy. The "shortage" of a resource is traditionally adopted as a criterion for evaluating resource depletion. To determine whether a resource is in short supply, a relationship is established between the factors consumption, potential renewal and reserves for a specific geographical unit.

Figure 1: Life cycle of the various feed mixtures and the use of synthetic DL-methionine
(The material flows refer to a complete broiler diet with a 1 kg higher methionine content than the basal mixture; the supply of methionine from rapeseed meal can be assessed in the same way.)

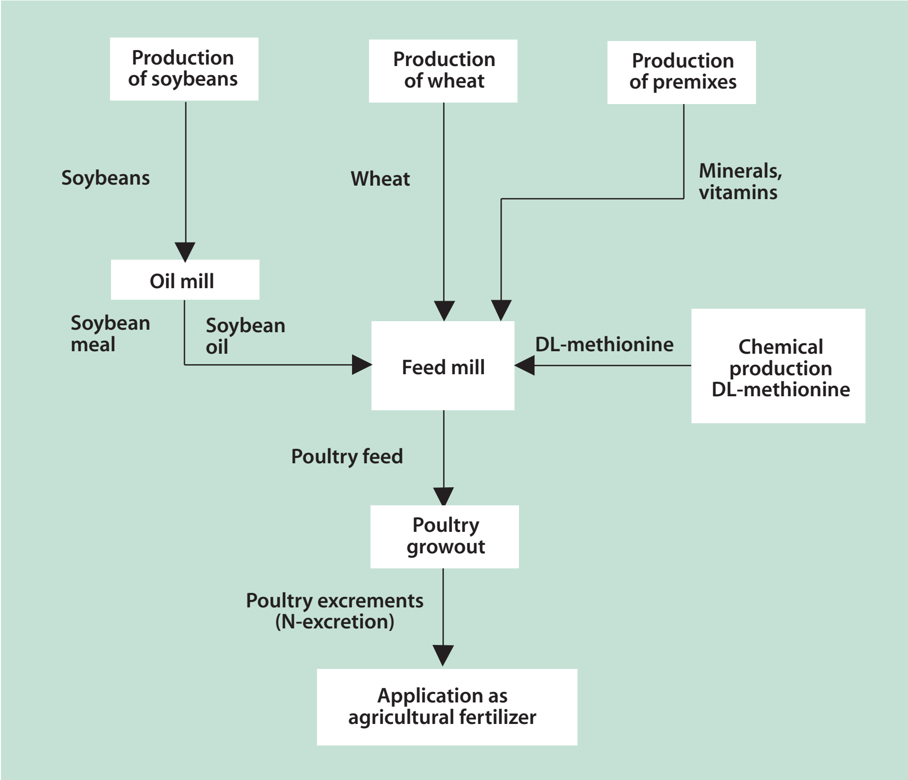


Figure 2: Simplified process chart of the chemical synthesis of DL-methionine from petrochemical raw materials by the Degussa process

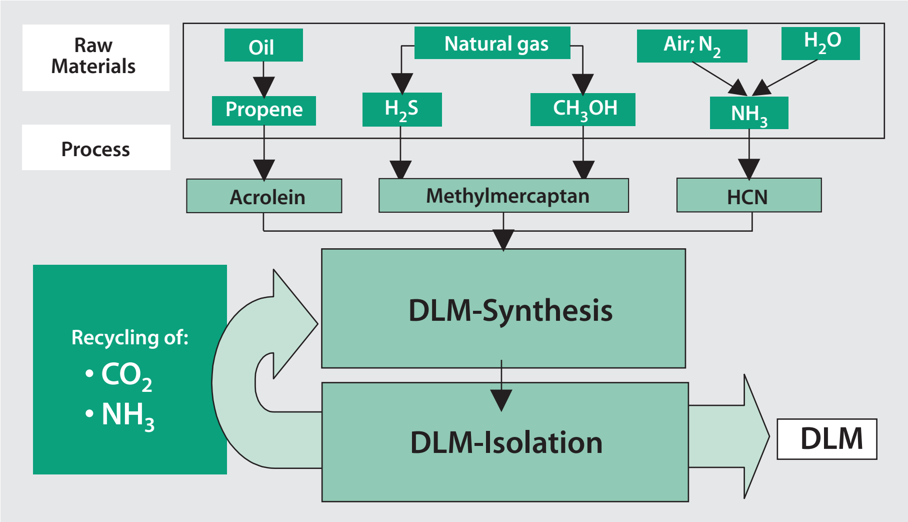
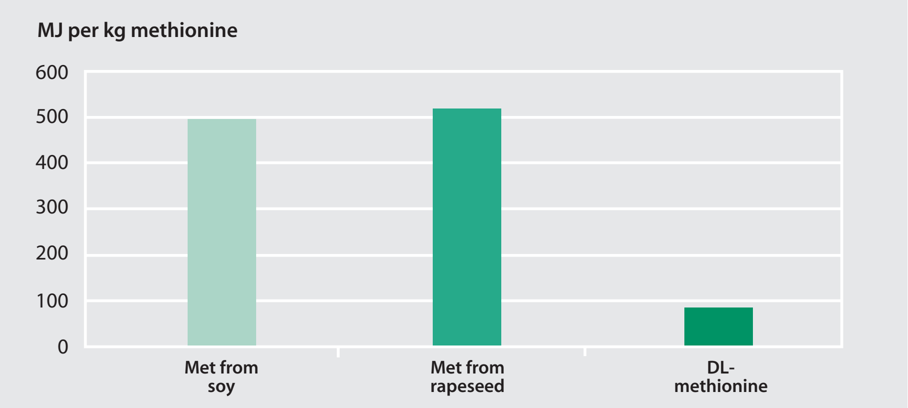


Figure 3: Cumulative energy consumption for 1 kg methionine. The methionine is derived either from chemical synthesis or from natural sources such as soybean meal and rapeseed meal (ifeu 2002).



Emissions

The different equivalent feed formulations in Table 1 show marked differences in their crude protein content while having identical energy and methionine contents. The nitrogen bound in the excess crude protein is not utilised efficiently by the animal's body but excreted and emitted into the environment as ammonia or nitrate. As a result, supplementation with synthetic methionine has distinct advantages over using higher proportions of plant-derived protein from soybean meal or rapeseed meal.

The chemical synthesis of 1 kg DL-methionine requires approximately 88 MJ of primary energy. Supplementation of the same amount of methionine via soybean meal or rapeseed meal involves a more than 6-fold greater energy consumption (Figure 3).

Besides distinctly lower emissions, chemical synthesis involves far less depletion of natural resources, expressed in crude oil equivalents per kg methionine. Due to differences in the way soybean meal and rapeseed meal are produced, the results for the two natural methionine sources differ, but are still well above the values for the chemical synthesis of DL-methionine (Figure 4). The high energy requirement for methionine from soy protein is due to the energy consumed during processing in the oil mill as well as due to that used for transporting the raw materials from the main producing countries of Brazil and USA to Europe (Figure 5). It should be noted that the energy consumption attributed to "Agriculture" reflects only the difference between 260 kg of soybean meal and 288 kg wheat. Therefore this becomes a very small figure.

Figure 4: Resource consumption in the provision of 1 kg methionine to supplement a methionine-deficient complete broiler ration. The methionine is derived either from chemical synthesis or from natural sources such as soybean meal and rapeseed meal (ifeu 2002).

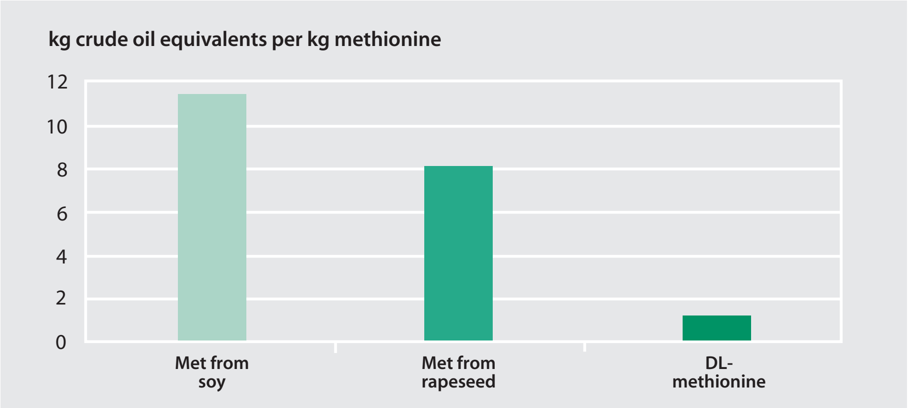
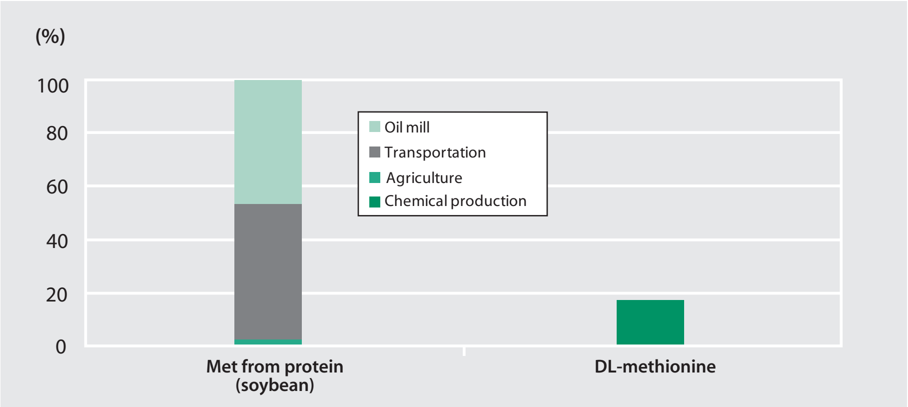


Figure 5: Relative specific contributions to energy consumption during different processing steps in the provision of 1 kg methionine (ifeu 2002)



Both the emission of ammonia (NH_3) into the air (terrestrial eutrophication; Figure 6) and the pollution of water with nitrates (NO_3^-, aquatic eutrophication; Figure 7) associated with the provision of 1 kg methionine can be greatly reduced.

Figure 6: Contributions to terrestrial eutrophication for the provision of 1 kg methionine either from chemical synthesis or from natural protein sources such as soybean meal or rapeseed meal (ifeu 2002)

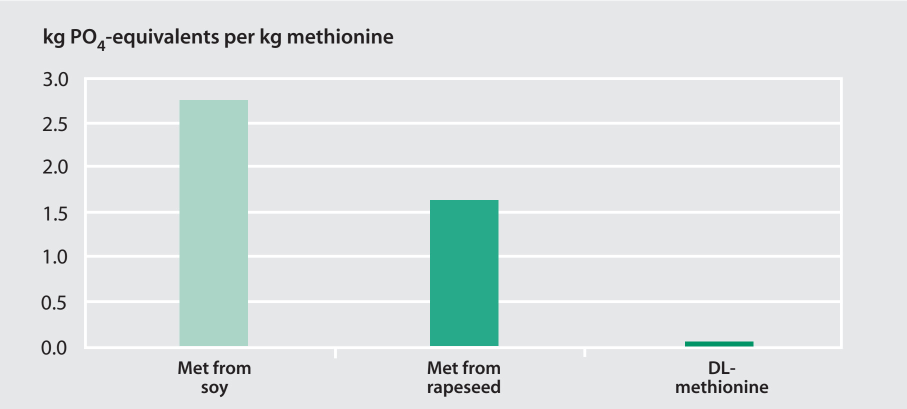
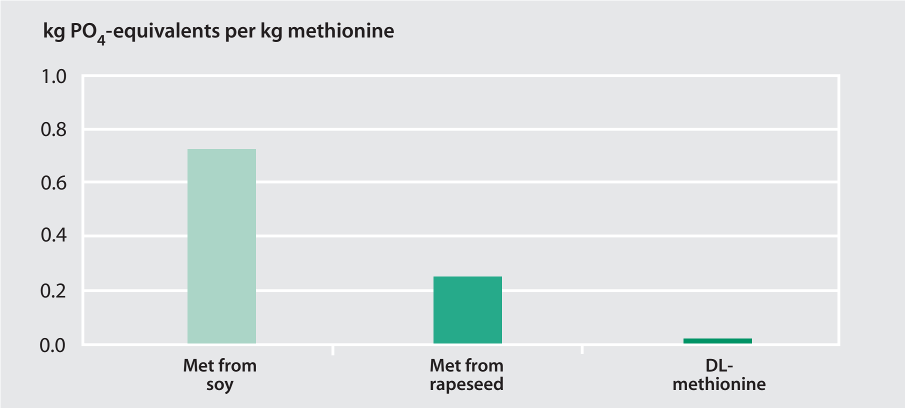


Figure 7: Contributions to aquatic eutrophication for the provision of 1 kg methionine either from chemical synthesis or from natural protein sources such as soybean meal or rapeseed meal (ifeu 2002)



Conclusion

Supplementation of broiler rations with synthetic DL-methionine represents a major contribution towards alleviating environmental pollution compared with the use of methionine-rich protein sources such as soybean meal or rapeseed meal. Firstly, the chemical production of methionine requires far less energy for achieving the same performance level with a given feed mixture. Secondly, it causes far lower environmental emissions. The lasting results are a saving of resources and a reduced emission of nitrogen and other compounds.

References

ifeu (2002): Ökobilanz für Methionin in der Geflügelmast / Life cycle analysis for methionine in broiler meat production. ifeu (Institute for Energy and Environmental Technology GmbH), Heidelberg.

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